Claims

1. A method for treating a gas sensor, comprising:

disposing said gas sensor in a basic agent solution comprising a basic agent comprising an element selected from the group consisting of Group IA of the Periodic Table of Elements, Group IIA of the Periodic Table of Elements, and combinations comprising at least one of the foregoing elements, wherein said gas sensor comprises an electrolyte disposed between and in ionic communication with a first electrode and a second electrode;

disposing said gas sensor in an acidic agent solution;

wetting at least a portion of a porous protective layer of said gas sensor with an alkaline-carbonate solution; and

heating said gas sensor.

2. The method of Claim 1, further comprising heating said basic agent solution and said acidic agent solution to boiling temperatures.

3. The method of Claim 1, wherein said acidic agent solution comprises hydrochloric acid.

4. The method of Claim 1, wherein said basic agent solution comprises about 2 wt% to about 45 wt% basic agent, balance water.

5. The method of Claim 4, wherein said basic agent solution comprises about 3 wt% to about 25 wt% basic agent.

6. The method of Claim 5, wherein said basic agent solution comprises about 5 wt% to about 20 wt% basic agent.

7. The method of Claim 1, wherein said acidic agent solution comprises about 2 wt% to about 25 wt% acidic agent, balance water.

8. The method of Claim 7, wherein said acidic agent solution comprises about 3 wt% to about 15 wt% acidic agent.

9. The method of Claim 8, wherein said acidic agent solution comprises about 4 wt% to about 10 wt% acidic agent.

10. The method of Claim 1, further comprising rinsing said gas sensor in water after disposing said gas sensor in said basic agent solution and before disposing said gas sensor in said acidic agent solution.

11. The method of Claim 1, wherein said gas sensor comprises an electrode impedance of less than or equal to about 100 ohms at 550°C.

12. The method of Claim 11, wherein said electrode impedance is less than or equal to about 50 ohms at 550°C.

13. The method of Claim 1, wherein said gas sensor has a pump current of greater than or equal to about 3 mA at 0.5 volts with a heater at 6.6 watts.

14. The method of Claim 13, wherein said gas sensor has a pump current of greater than or equal to about 3.5 mA at 0.5 volts with a heater at 6.6 watts.

15. The method of Claim 1, wherein said gas sensor has a pump current of greater than or equal to about 5 mA at 1 volt with a heater at 6.6 watts.

16. The method of Claim 15, wherein said gas sensor has a pump current of greater than or equal to about 7 mA at 1 volt with a heater at 6.6 watts.

17. The method of Claim 16, wherein said gas sensor has a pump current of greater than or equal to about 8.5 mA at 1 volt with a heater at 6.6 watts.

18. The method of Claim 1, wherein said alkaline-carbonate solution comprises a metal hydroxide-carbonate mixture.

19. The method of Claim 18, wherein said metal hydroxide-carbonate mixture further comprises hydroxides and carbonates of metals selected from the group consisting of Group I metals, Group IIa metals, Group IIIb metals, and combinations comprising at least one of the foregoing.

20. The method of Claim 19, wherein said metal hydroxide-carbonate mixture further comprises hydroxides and carbonates of metals selected from the group consisting of sodium, potassium, lithium, calcium, magnesium, cerium, yttrium, lanthanum, and combinations comprising at least one of the foregoing.

21. The method of Claim 18, wherein an amount of metal hydroxide in said metal hydroxide-carbonate mixture is about 0.1 wt% to about 15 wt%, based upon the total weight of said metal hydroxide-carbonate mixture.

22. The method of Claim 21, wherein said amount of said metal hydroxide is about 1 wt% to about 10 wt%, based upon the total weight of said metal hydroxide-carbonate mixture.

23. The method of Claim 22, wherein said amount of said metal hydroxide is about 2 wt% to about 7 wt%, based upon the total weight of said metal hydroxide-carbonate mixture.

24. The method of Claim 18, wherein an amount of metal carbonate in said metal hydroxide-carbonate mixture is about 0.15 wt% to about 25 wt%, based upon the total weight of said metal hydroxide-carbonate mixture.

25. The method of Claim 24, wherein said amount of said metal carbonate is about 0.5 wt% to about 20 wt%, based upon the total weight of said metal hydroxide-carbonate mixture.

26. The method of Claim 25, wherein said amount of said metal carbonate is about 2 wt% to about 15 wt%, based upon the total weight of said metal hydroxide-carbonate mixture.

27. The method of Claim 1, further comprising washing said gas sensor in an alkaline solution, following said heating of said gas sensor.

28. The method of Claim 27, wherein said alkaline solution comprises an alkaline cleaner selected from the group consisting of carbonates, alkalis, and combinations comprising at least one of the foregoing alkaline cleaners.

29. The method of Claim 27, wherein said alkaline solution comprises about 1 wt% to about 20 wt% of an alkaline cleaner.

30. The method of Claim 29, wherein said alkaline solution comprises about 2 wt% to about 15 wt% of the alkaline cleaner.

31. The method of Claim 27, further comprising heating said alkaline solution to a boiling temperature.

32. The method of Claim 1, wherein said heating said gas sensor comprises heating said gas sensor to a temperature of about 200°C to about 1,000°C.

33. The method of Claim 32, wherein said temperature is about 400°C to about 700°C.

34. The method of Claim 1, wherein said basic agent is selected from the group consisting of sodium hydroxide, lithium hydroxide, magnesium hydroxide, potassium hydroxide, cesium hydroxide, barium hydroxide, strontium hydroxide, calcium hydroxide, and combinations comprising at least one of the foregoing basic agents.

Filed - 2005-Feb

35. The method of Claim 1, further comprising pre-treating and porous protective layer by applying a catalytic layer comprising at least one metal selected from the group consisting of palladium, platinum, rhodium, transition metals, and combinations comprising at least one of the foregoing metals.

36. The method of Claim 35, comprising applying said catalytic layer to a thickness ranging from about 100 Angstroms to about 100 micrometers.

37. The method of Claim 36, comprising applying said catalytic layer to a thickness of about 0.1 to about 10 micrometers.

38. The method of Claim 35, further comprising applying said catalytic layer by a thin film deposition technique selected from the group consisting of sputtering, electron beam evaporation, chemical vapor deposition, and combinations comprising at least one of the foregoing techniques.

39. The method of Claim 35, further comprising applying said catalytic layer by a thick film deposition technique selected from the group consisting of screen printing, pad printing, ink jet printing, spraying or metallic-organism solutions, and combinations comprising at least one of the foregoing techniques.

40. The method of Claim 1, further comprising treating at least a portion of a porous protective layer of said gas sensor with a fluoride material, subsequent to disposing said gas sensor in an acidic agent solution.

41. The method of Claim 40, wherein said fluoride material is selected from the group consisting of ionic fluorides, covalent fluorides, fluorinating agents, and combinations comprising at least one of the foregoing fluoride materials.

42. The method of Claim 40, wherein said fluoride material is applied by wetting at least a portion of said porous protective layer with a fluoride solution.

43. The method of Claim 42, wherein said aqueous fluoride solution comprises a solution of a fluoride of a Group I element of the Periodic Table of Elements.

44. The method of Claim 42, wherein said fluoride solution comprises about 0.1 wt% to about 20 wt% of said fluoride material.

45. The method of Claim 44, wherein said fluoride solution comprises about 1 wt% to about 10 wt% of said fluoride material.

46. The method of Claim 42, further comprising heating the fluoride treated gas sensor to a temperature of about 600°C to about 1,000°C.

47. The method of Claim 46, wherein said temperature is about 700°C to about 900°C.

48. The method of Claim 42, wherein said treating with a fluoride solution is applied prior to wetting the porous protective layer with an alkaline-carbonate solution.

49. The method of Claim 42, wherein said fluoride solution is an aqueous fluoride solution.

50. A method for treating a gas sensor, comprising:

applying a catalytic layer to at least a portion of a porous protective layer of said gas sensor, said catalytic layer comprising a selected from the group consisting of palladium, platinum, rhodium, transition metals, and combinations comprising at least one of the foregoing metals;

disposing said gas sensor in a basic agent solution comprising a basic agent comprising an element selected from the group consisting of Group IA of the Periodic Table of Elements, Group IIA of the Periodic Table of Elements, and combinations comprising at least one of the foregoing elements, wherein said gas sensor comprises an electrolyte disposed between an ionic communication with a first electrode and a second electrode;

disposing said gases sensor in an acidic agent solution;

wetting at least a portion of a porous protective layer of said gas sensor with an alkaline-carbonate solution; and,

heating said gas sensor.

51. The method of Claim 50, further comprising washing said sensor in an alkaline solution, following said heating of said gas sensor.

52. A method for treating a gas sensor comprising:

disposing said gas sensor in a basic agent solution comprising a basic agent comprising an element selected from the group consisting of Group IA of the Periodic Table of Elements, Group IIA of the Periodic Table of Elements, and combinations comprising at least one of the foregoing elements, wherein said gas sensor comprises an electrolyte disposed between an ionic communication with a first electrode and a second electrode;

disposing said gas sensor in an acidic agent solution;

treating at least a portion of a porous protective layer of said gas sensor with a fluoride material;

wetting at least a portion of a porous protective layer of said gas sensor with an alkaline-carbonate solution; and

heating said gas sensor.

53. The method of Claim 52, further comprising washing said gas sensor in an alkaline solution, following said heating of said gas sensor.

54. A gas sensor formed in accordance with the method defined in Claim 1.

55. A gas sensor formed in accordance with the method defined in Claim 50.

56. A gas sensor formed in accordance with the method defined in Claim 52.

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